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ORGANIZATIONAL AND ECONOMIC MECHANISMS FOR COMMERCIALIZATION OF GREEN TECHNOLOGIES IN KAZAKHSTAN

Green technologies are essential tools to ensure sustainable development of the economy. The transition to a green economy requires changes in existing governance approaches, institutions, and markets. In this regard, authors analyzed the current state and implementation of green technology projects in Kazakhstan. Barriers identified through extensive literature review and semi-structured expert interviews were validated through discussions with with experts and twenty-one barriers have been categorized into six dimensions. They were placed on sheet by levels of authority to solve the problem and periods for changing the situation. Understanding various barriers leads to important lessons in designing policy instruments and institutions for diffusing green technologies. Research goal is to develop organizational and economic mechanisms for commercialization of green technologies in Kazakhstan. During the study, authors used comprehensive literature review, expert interviews, analysis and synthesis methods, and integral approach to elaborate mechanisms' framework. As a result, objects and subjects, basic principles, appropriate organizational and economic instruments, tools, four goals and eleven objectives were proposed. The proposed framework permits managers and practitioners to make decisions in the most effective way.

Key words: commercialization, green technology, organizational and economic mechanism, innovation management, sustainable development.

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Қазақстанда жасыл технологияларды коммерцияландырудың ұйымдастырушылық және экономикалық механизмдері

Жасыл технологиялар ел экономикасының тұрақты дамуының бірден-бір маңызды құралдарының бірі болып табылады. Жасыл экономикаға өту жолында қазіргі нарықтар, институттар мен басқару тәсілдерінде өзгеріс қажет. Осыған орай, мақала авторлары Қазақстандағы жасыл технологиялар саласындағы жобалардың ағымдағы жай-күйі мен орындалу барысына талдау жасады. Кешенді әдебиеттерге шолу мен жартылай құрылымдық сұқбаттар нәтижесінде анықталған жиырма бір кедергі сарапшылармен талдау барысында нақтыланып, алты санатқа топтастырылды. Олар жазықтыққа мәселені шешуге қажетті деңгей мен уақыт өлшемдеріне қарай орналастырылды. Жасыл технологияларды таратудағы кедергілерді түсіну осы саладағы саяси шешімдер мен институттар жүйесін құрудағы алғашқы қадам болып табылады. Зерттеудің негізгі мақсаты – Қазақстандағы жасыл технологияларды коммерцияландырудың ұйымдастырушылық-экономикалық механизмдерін әзірлеу. Зерттеу барысында әдебиеттерге жан-жақты шолу, сарапшылармен сұқбат, талдау және синтез әдістері, механизмдерді әзірлеуде кешенді әдіс қолданылды. Нәтижесінде, механизмдердің объектісі мен субъектілері, негізгі қағидалары, қажетті ұйымдастырушылық және экономикалық құралдар, төрт негізгі мақсат пен

он бір міндеттер анықталды. Ұсынылған кешен менеджерлерге аталған салада тиімді шешімдер қабылдауға мүмкіндік береді.

Түйін сөздер: коммерцияландыру, жасыл технологиялар, ұйымдастырушылық және экономикалық механизмдер, инновациялық менеджмент, тұрақты даму.

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Организационные и экономические механизмы коммерциализации зеленых технологий в Казахстане

Зеленые технологии являются важнейшими инструментами обеспечения устойчивого развития экономики. Переход к зеленой экономике требует изменения существующих подходов в управлении, институтов и рынков. В связи с этим, авторы проанализировали текущее состояние и ход реализации проектов по зеленым технологиям в Казахстане. Барьеры, выявленные в результате комплексного обзора литературы и полуструктурированных интервью, были подтверждены в ходе обсуждений с экспертами, и двадцать один барьер был сгруппирован по шести категориям. Они были размещены на плоскости относительно уровней власти, в которых решается проблема, и сроков для изменения ситуации. Понимание различных барьеров в коммерциализации зеленых технологий является необходимым условием в разработке комплекса инструментов. Целью исследования является разработка организационно-экономических механизмов коммерциализации зеленых технологий в Казахстане. В ходе исследования авторы сделали расширенный обзор литературы, использовали методы анализа и синтеза, интервью с экспертами, а также комплексный подход к разработке механизмов. В результате были предложены объекты и предметы, основные принципы, соответствующие организационные и экономические инструменты, четыре основные цели и одиннадцать задач комплекса механизмов. Предлагаемая структура позволяет менеджерам и практикам принимать наиболее эффективные решения в данной области.

Ключевые слова: коммерциализация, зеленые технологии, организационные и экономические механизмы, инновационный менеджмент, устойчивое развитие.

Introduction

Leading countries of the world view the «green» development of the economy as a priority strategy and Kazakhstan does not stand aside from this process. For many years, following work in this direction was conducted in the country: announcement of the «Environmental Protection» year (Almaty Declaration, 1997), adoption of the Environmental Code (2007), creation of the Council for Sustainable Development (Resolution of the Government, 2004), launching of the partner program «Green Bridge» (GBPP, 2011), establishing a «Green Academy» (GA, 2013), adoption of various governmental programs to support this policy, etc. In addition, an important role in the promotion of green technologies was played by the international specialized exhibition EXPO-2017 with the theme «Future Energy», which was attended by about 100 countries around the world and about 10 international organizations (EXPO, 2017). Turning point in sustainable development of the country was the adoption of Concept of transition of the Republic of Kazakhstan to the «green economy» in 2013. It is expected to strengthen the development and implementation of green technologies and increase public awareness in our country. Observing the significant progress in creating the prerequisites for a «green economy» in Kazakhstan, one can notice that there is a need to analyze domestic scientific developments and their potential in the market of commercialization.

Despite the adoption of the Law of the Republic of Kazakhstan «On the commercialization of the results of scientific and (or) scientific and technical activities» in 2015 (CL, 2015), there are still significant barriers to the commercialization of research results even in conventional industries. Problems like fragmented links between science and industry, weak management of commercialization of technology are applicable to all research fields; however, as research shows, distinctive approach should be applied to R&D in green development field. In this regard, the study of commercialization management of green technologies is particularly relevant.

Literature review

Development of proposals for the development and improvement of the commercialization system requires an integrated approach. The study of organizational and economic mechanisms is an object of scientific interest for many modern scientists conducting research both in the field of commercialization of innovations and in other spheres of the economy. At the same time, the authors in their works either do not define the organizational and economic mechanism even in cases when the title of the article is directly implied it, or offer a narrow interpretation depending about the research.

Udaltsova N.L. (2012) gives another definition. According to her, the organizational and economic mechanism is an important part of the entire economic mechanism and can be defined as a set of organizational and economic structures and levels of governance, including legislative, financial, economic and organizational-administrative methods of impact, providing continuous development of the facility on the basis of the principles of the goal-oriented, systematic, integrated realization of the potential, adaptability, coherence of interests of interacting subjects, innovativeness.

Agaeva L.K. (2013) defines it «as an aggregate of organizational and economic forms and methods, instruments and levers of influence on the object, linked in a single mechanism that allows achieving the maximum beneficial effect and stable financial and economic activity in the immediate and further perspective».

We share the position of researchers who view the organizational-economic mechanism as a hierarchical system when private mechanisms function at lower levels, each of which performs its functions and affects the efficiency of the system as a whole, and their unification creates a new category – a complex organizational and economic mechanism (Fedorovich, 2006; Novikov, 2011).

The definition of Ilina S.A. (2016) is best suitable for this study: the organizational and economic mechanism of commercialization of innovations is a complex of interrelated and interacting elements that form a single whole, acting to effectively commercialize innovation, as well as subsystems of a lower level (private mechanisms).

In general, almost all definitions of the organizational and economic mechanism are characterized by the prevalence of the system approach. Elements of such a system are:

– objects – a managed element;

– the center is the control element that acts on the object;

– subjects – the carriers of substantive and practical activities involved in the work of the «mechanism»;

– economic and organizational methods, levers and instruments of influence;

– algorithm for implementing the mechanism. In this case, the subject of this type of mechanism can coincide with the center. The state bodies, various companies, and public organizations can be a center of the management mechanism (Bychkova, 2010).

Approaches to the formation of economic mechanisms as a tool of interaction and impact differ mainly in the degree of influence of the center on the process of implementing the mechanism. The application of each of them is expedient for solving various tasks, depending on the degree of necessity of participation of the center.

To apply this approach in our study, there was a need to analyze all identified barriers and identify responsible bodies for their solution.

Materials and methods

The quantitative methods of research have long won strong positions in scientific research. These methods assume that the characteristics of the social environment constitute an objective reality that is relatively constant in time and within certain parameters. The dominant methodology of the quantitative research is to describe and explain the characteristics of the external behavior of this reality by collecting numerical data on the objects under study. Subsequently, these accumulated data are subjected to statistical analysis.

Qualitative research methods assume that individuals build social reality in the form of meanings and interpretations and that these designs, as a rule, are temporary and dependent on the situation. The dominant methodology, in this case, is to discover these meanings and explanations (interpretations) by an intensive study of situations in the natural conditions provided that the necessary data are subjected to their analytical induction (Gall et al., 2006).

Both research approaches have different contextual differences, while qualitative studies can complement quantitative studies to obtain more reliable results (Esimzhanova, 2001). In this study, both quantitative and qualitative methods of analysis are used. The quantitative method of this research work is based on statistical and microeconomic

analysis to present certain calculated values for constructing theoretical conclusions. The calculated values represent a convincing scientific proof of how events occur and by what principle they work. Carrying out of qualitative research assumes acknowledgment of results of the quantitative analysis.

In the research work, a method of peer review is used, which involves obtaining an expert opinion on the issue under investigation, drawing on the experience, knowledge, and recommendations contained in the judgments of competent specialists (Orlov, 2002). The generalized view of experts obtained because of quantitative evaluation and processing of results allows receiving an informed decision, to understand the existing laws or to plan the forecast of further directions of action. The method of expert assessments as a scientific research tool makes it possible to solve many problems, to determine the ordered order of objects (phenomena), factors, options for actions, etc. by the degree of their importance.

To solve the set research problems, the most common method is interviewing as one of the main forms of expert assessments and preferred methods for gathering the necessary information (Litvak, 1982). Various types of interviews can be used to obtain peer reviews (Bryman, 2012). The interview can be structured, unstructured or semi-structured (Kvale, 1996).

We aimed to consider the commercialization issues of green technologies in Kazakhstan as the main tool of establishing sustainable economy. Previously, 23 interviews with experts in green technology were conducted and analyzed (Zhidebekkyzy, 2016). Conducted expert interviews have allowed revealing some factors that were noted during the preliminary literature review. As a result, we have selected the most significant factors and important barriers that affect the successful commercialization of green technologies in Kazakhstan

To validate of the identified barriers to commercialize green technologies have been carried out the experts from academia and industry. A workshop was conducted in which experts (four from academia, two from management and two from industry) were invited for a brainstorming session to seek their opinion on how important a role the barriers play in hindering the implementation of green technologies in the Kazakhstani context. Barriers identified through extensive literature review and semi-structured expert interviews were validated through discussions with experts (academia and senior/middle-level engineers/managers) and twenty-one barriers have been categorized into six dimensions based upon their nature in adoption of green technologies, i.e. Financial & Economic, Infrastructure & Technical, Legislative, Personnel & Staff, Socio-cultural, Personal. These identified barriers to commercialize green technologies are shown in Table 1.

Table 1 – The priority weighting and ranking of barriers to commercialize green technologies

Dimensions of barriers	Barriers
Financial & Economic (FE)	High costs of necessary technologies (FE1)
	Lack of funding for R&D phase (FE2)
	Low wages of scientists (FE3)
	High initial costs for own production (FE4)
Infrastructure & Technical (IT)	Insufficient material base (IT1)
	Lack of national infrastructure (IT2)
	Poor communication (IT3)
	Priority for foreign ready-made technologies (IT4)
Legislative (LE)	Lack of intellectual property protection (LE1)
	Lack of incentives for industry (LE2)
	Drawbacks in commercialization law (LE3)
Personnel & Staff (PS)	Lack of trained people in innovation management (PS1)
	Lack of experience (PS2)
	Isolation of consulting specialists from industry (PS3)
	Lack of understanding among officials (PS4)
Socio-cultural (SC)	Low demand in domestic market (SC1)
	Low purchasing ability of population (SC2)
	Lack of awareness (SC3)
Personal (PL)	Reluctance of a scientist to engage in commercial process (PL1)
	Overlooking proper market research (PL2)
	Faith & Beliefs (PL3)
Note – compiled by authors based on own research	

We placed them on the sheet according to two questions:

1. Who is responsible for solving or eliminating this barrier?

2. How long will it take to improve the current situation?

By answering to these questions, we distinguished three levels of authority – macro, meso and micro levels; three periods for changing the situation – short-term (up to 2 years), medium-term (3-5 years) and long-term (6 years and more). The results are presented in Figure 1.

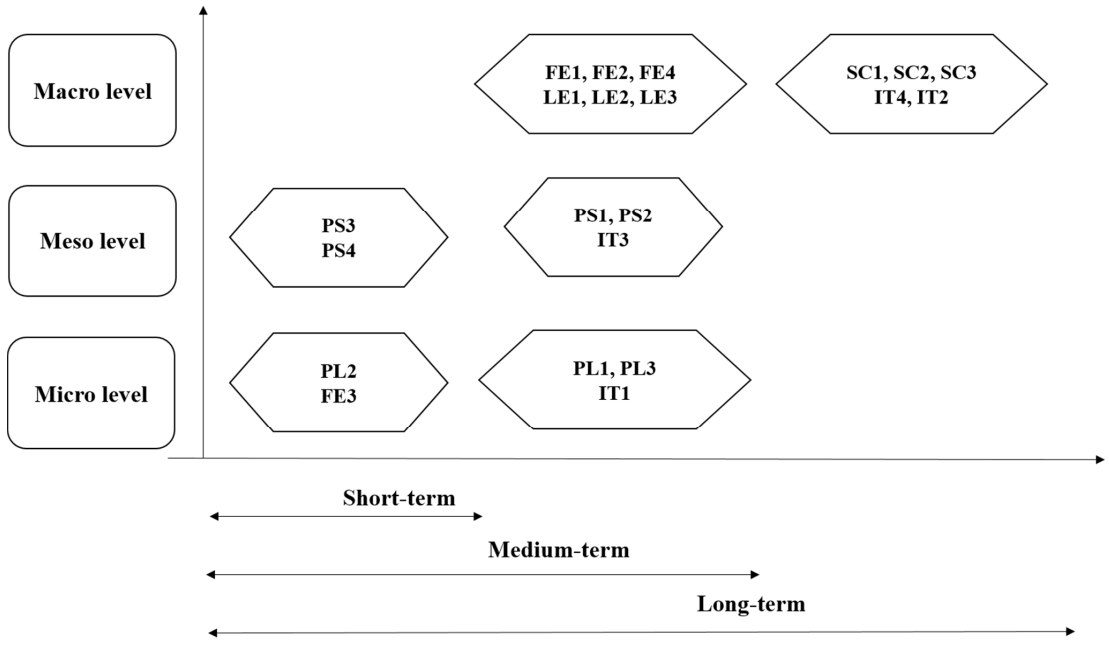

Figure 1 – Positioning of barriers according to period and decision-making level
Note – compiled by authors based on own research

This analysis may play an important role in understanding various barriers, and ranking of these will help in their removal to commercialize green technologies in Kazakhstan more effectively and efficiently. This analysis has presented a benchmarking framework to make complicated decisions towards the removal of these barriers. Understanding barriers in technology diffusion leads to important lessons in designing policy instruments and institutions for diffusing green technologies in developing countries like Kazakhstan. The proposed framework permits managers/practitioners to make decisions in the most effective and efficient way.

Results and discussion

As results show, most of Financial & Economic barriers (FE1, FE2, FE4) are strictly related to policy of financing at the state level and implies at least medium-term period to increase current figures.

Similarly, legislative framework is also regulated by state and requires a time to be adjusted. For example, scientists pointed at inefficiency of new Commercialization law. However, state bodies need a time to evaluate the influence of current edition. Therefore, LE3 and LE1 are situated for macro-level and at least medium range of time. LE2 is a complicated step in forming a necessary legal base for encouraging industry to implement domestic scientific research results in green technology field.

Barriers related to human resources issues could be solved at meso level by providing proper training and education (PS1, PS2). These two barriers are related to IT3, that is poor communication. PS3 and PS4 are substantial drawbacks, however, ensuring proper training and discussing the problem with officials would lead to the quick improvement on this matter.

PL2 is conditioned by lack of pre-research and ignoring of «market-pull» principles. Therefore, universities or research institutes are directly responsible for ensuring proper choice of research topics. FE3 is also could be solved by wage policy

at micro level, even though it is dependent on macro policy sets.

Socio-cultural factors like SC1, SC2 and SC3 are essential in transition to green economy. «Green» thinking leads to forming a domestic market, demand for environmental-friendly products, and high commitment to sustainable growth principles. However, change in these factors could take years to occur, and strong government support is vital.

IT4 barrier could not be eliminated before there will be competitive domestic alternatives, so it is applied for long-term period and requires support at macro level. Same can be said to IT2.

Regarding PL1, PL3, there is a positive anticipation that active promoting of commercialization of science will lead to higher involvement of scientists to commercialization process.

IT1 barrier are dependent on macro policy of funding. However it is more responsibility of universities, research institutes, and laboratories to organize a proper work opportunity.

Regarding the organizational and economic mechanism for introducing green technologies, the degree of influence of the center (the state bodies and structures) at various stages can be different, and it seems possible to form an integrated approach to the formation of such a mechanism. Taking into account the proposed approach, we have formed an integral approach to the development of to the management of commercialization of green technologies system.

Proposed organizational and economic mechanism is presented in Figure 2a and Figure 2b.

According to this system:

1. Object of the mechanism is organizational-economic relations arising in the process of introduction of green technologies.

2. Subject of the mechanism is existing and created entities planning the introduction of green technologies.

3. Core is an element that creates the rules for the most effective implementation of the mechanism.

Based on of generalization of existing approaches, following basic principles can be distinguished:

– the principle of purposefulness: the main goal of this system is ensuring achievement of the country's sustainable development goals;

– the principle of profitability: the choice of tools should ensure the achievement of goals with the efficient use of resources;

– the principle of adaptability: rapid response to various changes in the external environment, including the possibility of transformation from the mechanism.

The implementation of the proposed mechanism should be provided by appropriate organizational and economic instruments.

The necessary tools for are:

– regulatory and legal support for the functioning and strategic development of the system;

– measures of indirect state support of innovative development;

– financial security – improving and increasing the availability of financial instruments.

Four goals are set to ensure the achievement of the main goal:

1. Creating favorable conditions for a green growth.

2. Ensuring the emergence of new green technologies.

3. Promoting diffusion of green technologies.

4. Development of necessary human resources.

11 objectives in total are dedicated to attainment of goals set in a mechanism.

Conclusion

By analyzing current situation in Kazakhstan regarding green economy, we propose next measures to develop this process of moving toward sustainable development:

1. Support attracting private investment for R&D and the commercialization of green innovations. Proper policy development should ensure competitive selection processes, focus on productivity, rather than on specific technologies, avoid favouring existing officials or create opportunities for lobbying, provide a rigorous impact assessment policy and contain costs.

2. Combine support for green and general-purpose technologies. Creating efficient infrastructure will be beneficial for any technologies.

3. Assistance to the growth of new entrepreneurial firms. New entrepreneurial firms play an essential role in providing green innovations that challenge existing firms and business models. The policy should create space for such new firms, allowing them to enter, exit and grow, ensure fair competition and improve access to finance, which remains the main obstacle to entry and growth of young firms.

4. Diffusion enhancement to promote the wide dissemination of «green innovation» within and between countries. It is necessary to explore new approaches to the dissemination of knowledge and technology.

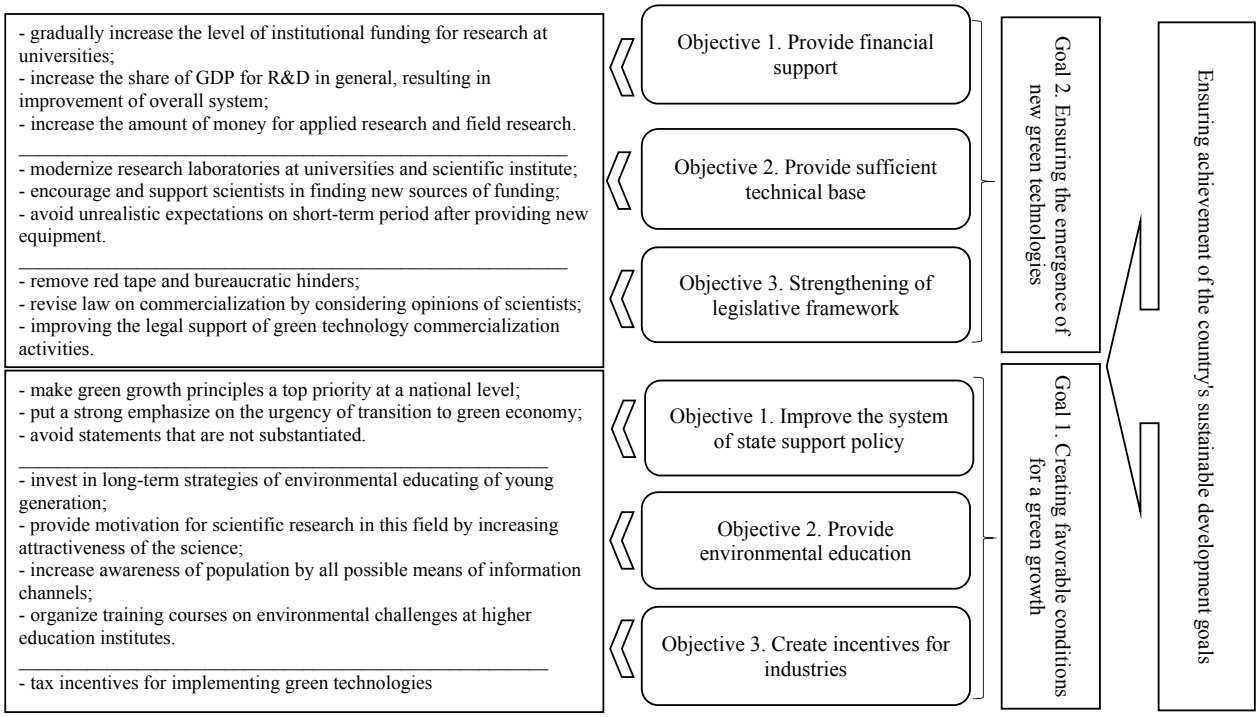

Figure 2a – Organizational and economic mechanism for commercialization of green technologies
Note – compiled by authors based on own research

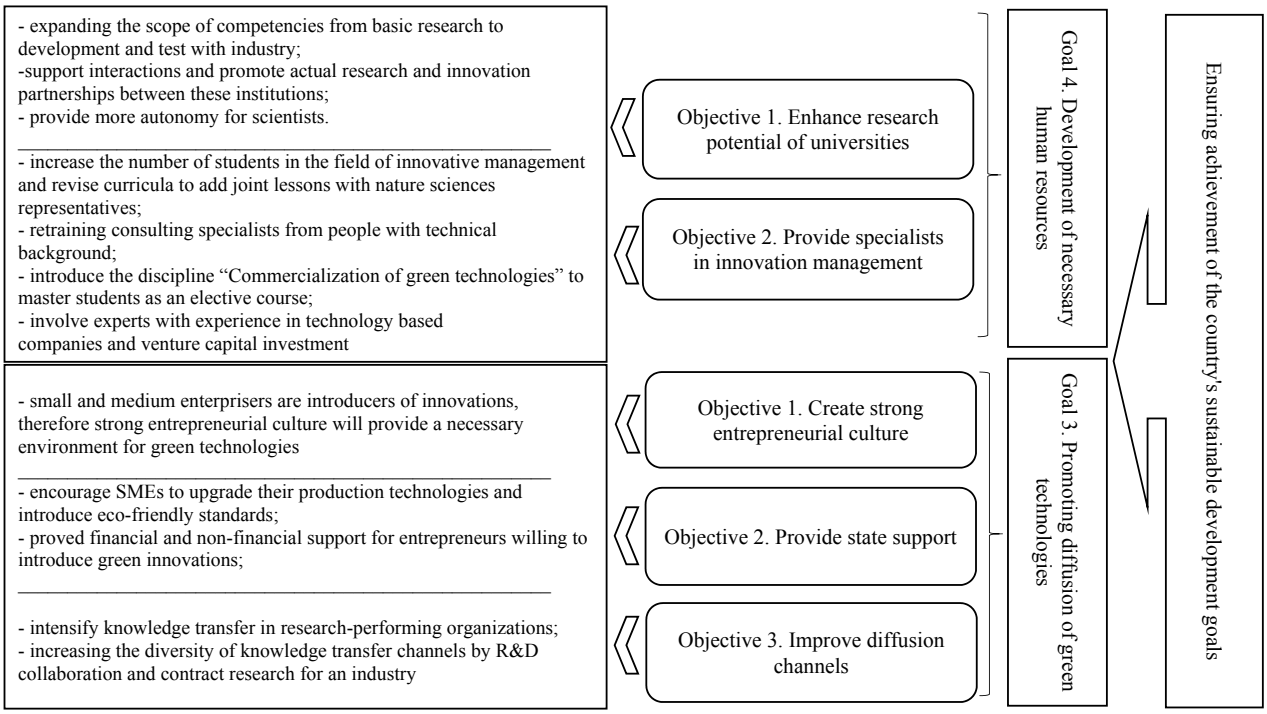

Figure 2b – Organizational and economic mechanism for commercialization of green technologies
Note – compiled by authors based on own research

5. Strengthen markets for green innovation and changing consumer behavior.

The policy also needs to consider the timeframe and the potential benefits and risks of implemented policies. Some developments are already available in the market; some may be still under development, or in a demonstration or pre-demonstration phase. Others will only emerge over a much longer time and will require further research and development. Political efforts will differ during this timeframe, from basic research to pre-competitive research and demonstration efforts, to policies aimed at developing or shaping the market.

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